Greening The Building(MNT)

Location and Transportation	8/15
Sustainable Sites	5/12
Water Efficiency	7/12
Energy and Atmosphere	22/31
Material and Resources	6/13
Indoor Environment Quality	14/16
Innovation	4/6
Total	66/105

MNT consumption 2018: 2171891kWh

Leed V4.1 Points: 66/105
Certification Level----Gold

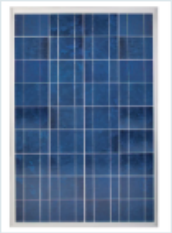
Cost: $384150
Payback Period: 4 years

Annual Saving:
Solar Power:825644kWh
HVAC:81121kWh
LED Lights: 91980kWh

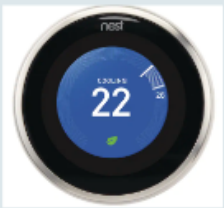
MNT Consumption Afterward: 1473146kWh

METHOD:

Solar Panel
Transforming the building into a microgrid, storing & supplying power to the building



Google Nest Thermostats
Smart learning thermal control device, saves around 25% of HVAC heating/cooling energy consumption



LED Lighting
Upgrading to LED lighting can help us reduce the energy usage by 75% compared to incandescent lighting

According to the ""uOttawa Consumption details" file, the power consumption of MNT in 2018 is 2171890kWh

Rooftop Solar Panel Installment

Solar Panel Information

Nominal Maximum Power (Pmax)	290Wp(watts peak)
Open Circuit Voltage (Voc)	39.9V
Maximum Power Point Voltage (Vmpp)	31.4V
Short Circuit Current (Isc)	9.91A
Maximum Power Point Current (Impp)	9.33A
Maximum Reverse Current	25A
Operating Temperature	-40 degree to 80 degree Celsius
Module Efficiency	17.3%
Maximum System Voltage	1kV
Power Sorting	0Wp/5Wp
Dimension	1.675 x 1.0 x 0.033 m

Space calculation

Roof Dimension	65m by 40m
Area for panel placement	2600m^2
Length of 35 panels in a row(series connection)	35m
Width of 35 panels in a row	1.647m
Distance between 2 rows	1m
Total number of rows	24
Total space for installation	2.647*24*35=2223.48m^2

Output Overview

Output voltage for each row (series connection)	31.4*35=1099V
Output current of each row	9.33ADC
Total output voltage	1099V
Total current output	9.33*24=223.92ADC
Total power output	1099*223.92=246.08808 kW
Hours of work daily	6 hours
Annual power output	356*6*246.08808kW=525644.138kWh
Percentage of Demand load(2361.91kW)	246.08/2361.97=0.104=10.4%

Solar panel will save over 525644kWh per year. And the renewable energy percentage will reach11.926% > 10% which means 5 points for renewable energy in the LEED checklist

To transport the power from the solar panel, Pigeon conductor is used.

Google Nest Learning Thermostat Energy Save Overview

HVAC demand load for MNT	127kW*7=889kW
Total Demand Load	2361.91kW
Energy saved	889kW*25%=222.25kW
Annual energy saved	222.25kW*365=81121.25kWh
Percentage of Demand Load	222.25kW/2361.91kW=9.4%

The device saves 9.4% of the demand load of the entire building, contributing 1 bonus mark on the Energy and Atmosphere check list.

Led Light Overview

Upgrading to LED lighting can help us reduce the energy usage by 75% compared to incandescent lighting. Contributing bonus mark on energy and atmosphere checklist

Lighting load demand	28kW
LED light energy saved	28*0.75=21kW
Annual Saving	21kW*12h*365=91980kWh

LEED v4 for BD+C: Schools

Location and transportation	Demonstration	Points
LEED for Neighborhood Development Location	N/A	
Sensitive Land Protection	N/A	
High Priority Site	N/A	
Surrounding Density and Diverse Uses	Other university buildings, 50% driver traffic usage	2
Access to Quality Transit	Bus stops, OTrain station	4
Bicycle Facilities	Bicycle parking space beside the building	1
Reduced Parking Footprint	No parking available	1
Green Vehicles	N/A	0
		Total:8

Sustainable Sites	Demonstration	Points
Construction Activity Pollution Prevention		Required
Environmental Site Assessment		Required

Site Assessment	Hydrology, Climate, Vegetation, Species, Soils, Human use, Human health effects	1
Site Development - Protect or Restore Habitat	N/A	0
Open Space	outdoor space ≥ 30% of the total site area	1
Rainwater Management	Effective	2
Heat Island Reduction	N/A	0
Light Pollution Reduction	N/A	0
Site Master Plan	N/A	0
Joint Use of Facilities	Lab, gym, basketball court, office etc.	1
		Total:5

Water Efficiency	Demonstration	Points
Outdoor Water Use Reduction	No irrigation required	1
Indoor Water Use Reduction	WaterSense-labeled high efficiency toilet, water fountain, limited lab usage	5
Building-Level Water Metering		Required
Cooling Tower Water Use	N/A	0
Water Metering	Installed	1
		Total:7

Energy and Atmosphere	Demonstration	Points
Fundamental Commissioning and Verification		Required
Minimum Energy Performance		Required
Building-Level Energy Metering		Required
Fundamental Refrigerant Management		Required
Enhanced Commissioning	Complete the commissioning process	4
Optimize Energy Performance	Energy cost savings percentage LED, thermal stats	11
Advanced Energy Metering	Acuvim II (tenant-level energy meter)	1
Demand Response	Google Nest Learning Thermostat (saving 9.4% on-peak electricity demand)	1
Renewable Energy Production	Solar panels on roof	5
Enhanced Refrigerant Management	N/A	0

Green Power and Carbon Offsets	N/A	0
		Total:22

Material and Resources	Demonstration	Points
Storage and Collection of Recyclables		Required
Construction and Demolition Waste Management Planning		Required
Building Life-Cycle Impact Reduction	Reusing existing building resources	3
Building Product Disclosure and Optimization - Environmental Product Declarations	Environmental product declaration	1
Building Product Disclosure and Optimization - Sourcing of Raw Materials	Environmental product declaration	1
Building Product Disclosure and Optimization - Material Ingredients	Environmental product declaration	1
Construction and Demolition Waste Management	N/A	0
		Total:6

Indoor Environmental Quality	Demonstration	Points
Minimum Indoor Air Quality Performance		Required
Environmental Tobacco Smoke Control		Required
Minimum Acoustic Performance		Required
Enhanced Indoor Air Quality Strategies	Air ventilation and filtering system	2
Low-Emitting Materials	Paint and coating, adhesive and sealant, flooring and wall panel, ceiling, furniture etc.	2
Construction Indoor Air Quality Management Plan	Meet all applicable recommended control measures of the SMACNA	1
Indoor Air Quality Assessment	Contaminants do not exceed the limited levels	2
Thermal Comfort	heating, ventilating, and air-conditioning (HVAC) systems	1

Interior Lighting	LED	2
Daylight	Window ceiling	2
Quality Views	Open-floor window	1
Acoustic Performance	Sound absorbing layer inside the halls	1
		Total:14

Innovation	Demonstration	Points
Innovation	Microgrid, energy saving, environmental material recycling	4
LEED Accredited Professional	N/A	0
		Total:4

Financial Feasibility Study

Components	Price per unit(USD)	Quantity required	Total cost
Solar panel	248.85	840	209034
Solar Inverter	1146.4	2	2292.8
500kVA transformers	11855	1	11855
Protection combiners	3440	7	27520
Google nest learning thermostat	264	7	1848
LED light	235	560	131600
			Total:384149.8

Cost-Benefit Study

Total Energy Saved annually	81121.25+91980+525644=698745.25kWh
Price for 1kWh	15cents
Annual cost saved	698745.25kWh*15/kWh=$104811.788
Payback Period	4 Years

Assumptions:

18455m^2 per floor of MNT, for each 230m^2, $235 of LED light is needed

Google nest learning thermostat saves 25% of energy as it advertised, one for each floor

One protection combiner is needed for each floor

All numerical assumption are based on 2021 Canadian Standards Association

Reference

https://store.google.com/CA/product/nest_learning_thermostat_3rd_gen?hl=en-GB

https://www.homedepot.com/b/Electrical-Renewable-Energy-Solar-Panels/N-5yc1vZcdrk

https://www.amazon.ca/Hybrid-Inverter-Controller-Lithium-Batteries/dp/B096XRJW7G

https://ledlightscanada.com/

https://www.se.com/ca/en/product/EE500T79H/transformer-dry-type-500kva-600d208y120/